NAVAL RESEARCH

REVIEWS

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Portraits in Science

Captain Robert D. Conrad, U.S.N. (1905-1949)

A second generation "bird-dog," Capt. Conrad served on the staff of OCRD and O.R.I., O.N.R's predecessors, and was largely responsible for evolving and developing unprecedented policies involving administration of Navy research contracts with universities. Capt. Conrad also visited top universities and influenced scientists, ready to return to former pursuits, to accept these contracts.

The Navy's top scientific award, the Captain Robert Dexter Conrad Award for Scientific Achievement, made annually to the individual, military or civilian, who has made an outstanding contribution to Navy research and development was named for Captain Conrad. The legion of Merit was among his other awards.

Birth Order Effects

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Investigations of the effects of birth order have a long, if not altogether reputable, history in psychology. The relationship between birth order and the attainment of intellectual eminence was first noted by Sir Francis Galton in 1874.* By using such criteria as being a Fellow of the Royal Society, Galton concluded that oldest and only children were more likely to achieve eminence than younger children. A generation later, Havelock Ellis found the same relationship between birth order and eminence.†

Despite these and other similar findings, the topic has been in ill repute for several reasons. Although a large number of studies have found significant differences between first- or only-borns and later-borns on a wide range of variables, much of this data is inconsistent and contradictory. Also, most researchers have considered that an individual's ordinal position has less psychological meaning than other factors, such as intelligence, extroversion, or anxiety level. As a result, interest in birth order phenomena has languished for a number of years. Recently, however, beginning with research being conducted by Stanley Schachter at Columbia University, concern with the phenomena has revived.‡

Schachter conducted a series of experimental studies on gregariousness. In particular, he investigated the hypothesis that people have an increased need for the company of others while under high stress. In his laboratory studies, subjects waiting for either mild or extremely painful electric shocks were offered the chance to wait alone or in the company of others. Schachter found, in support of his hypothesis, that stress does increase gregariousness—but primarily for first- and only-borns. Numerous subsequent studies have confirmed that first- and only-borns respond to stress by showing a greater desire for affiliation with others than do later-borns. Since much of the current research on birth order effects centers around reactions to stress, this will be the primary focus in the article. First, however, a brief review of other relatively stable findings concerning ordinal position is in order.

Galton's early finding that first- and only-borns achieve more than later-borns has been reaffirmed in present-day American society. Objective indices of accomplishment such as *Who's Who* and rosters

*Galton, F., *English Men of Science,* London: McMillan & Co., 1874.
†Ellis, H., *A Study of British Genius,* Boston: Houghton Mifflin, 1926, new revised edition.
‡Schachter, S., *The Psychology of Affiliation,* Stanford: Stanford University Press, 1959.

of scientists include an overproportionate number of first- and only-borns. Also, data show that eldest offspring are more intelligent than younger children and that enrollments in the more "elite" colleges have higher percentages of first- and only-borns.* Although some of this over-representation may be due to the fact that the eldest son typically has the greatest opportunity for advancement, the findings are so stable that it is warranted to conclude that order of birth has a strong effect on motivation and performance. First- and only-borns are also more likely to volunteer for special tasks ranging from events as prosaic as laboratory psychological experiments to experiences as hazardous as space flight.

Although attempts to isolate ordinal position differences in personality (as measured by standard personality tests) have generally produced contradictory results, two relatively stable findings have emerged. One is that first- and only-borns probably have a higher motivation for achievement than later-borns. This means that oldest and only children tend to show more need to achieve in competitive situations as measured by various psychological and behavioral tests. The second finding is that first- and only-borns exhibit greater dependency than do later-borns. This has been demonstrated primarily in research with children where first- and only-borns make more approaches to adults and are less independent in their behavior.

One additional and more tenuous birth order effect proposed is that first- and only-borns have a lower level of self-esteem than later-borns. This effect has been measured primarily by psychological tests which indicate that oldest and only children have less confidence in their own ability and less certainty about their proficiency in various skills.

The apparent superiority of first- and only-borns in achieving academic and professional eminence stands in marked contrast to the evidence concerning performance under stressful conditions. Schachter, in his original study, reanalyzed data on the performance of fighter pilots during the Korean War.† He found that under the stressful conditions of combat, first- and only-borns were inferior in performance when judged on the criterion of number of Migs shot down; *i.e.*, later-borns were significantly more likely to achieve "Ace" ranking as pilots.

More recently, the author collaborated with Dr. Roland Radloff of the Naval Medical Research Institute in studying the performance and psychological reactions of divers on Project Sealab II.‡ In the Sealab situation, an excellent, objective criterion of performance was available—the amount of time spent by each diver working in the

*Altus, W. D., "Birth order and its sequelae." *Science, 151,* 44-48, 1966.

†Schachter, S., *op. cit.*

‡Radloff, R., and Helmreich, R., *Groups Under Stress: Psychological Research in Sealab II.* New York: Appleton-Century-Crofts, in press.

The Sealab situation provided an excellent criterion of performance—the amount of time spent by each diver in the water

extremely stressful underwater environment outside the Sealab capsule. The average diving time per day over the 15 days spent underwater by each team ranged from 13 minutes to 72 minutes, with an overall average of 48 minutes for the three ten-man teams. Using this measure, the performance of later-borns was significantly better than that of first- and only-borns. The later-borns had an average of more than 56 minutes of diving per day while the first- and only-borns logged slightly less than 43 minutes per day.

Another measure employed in Sealab was a questionaire which was designed to assess the individual's level of fear while underwater. This test, given every other day for an average of seven times per man during the dive, indicated that first- and only-borns reported themselves as significantly more frightened than later-borns throughout their sojourn underwater.

The fact that eldest and only children volunteer disproportionately more than their later-born counterparts for both stressful and non-stressful undertakings seems paradoxical in light of the provocative finding that first- and only-borns do not perform as well under stressful conditions. It seems strange that they would expose themselves selectively to situations in which their performance tends to be of a lower caliber than that of later-borns. Yet, data on selective volunteering and acceptance for hazardous and stressful experiences seem unequivocal. All seven of the original Mercury astronauts were first-born or eldest in their family. Twelve of 15 candidates for the Gemini program were

the oldest or only male offspring.* Sixteen of the 28 Sealab aquanauts were eldest or only children. In a study currently being conducted by the author, 55 percent of a large sample of Army helicopter pilot trainees are eldest children, a finding which is in marked contrast to a non-volunteer sample of male University of Texas students of the same age which includes slightly less than 40 percent first-borns. Thus, for those concerned with both the nature of volunteer populations and the selection of candidates for hazardous duty, birth order appears to be a meaningful bit of information.

Theoretical Interpretations of Birth Order Effects

The most likely theoretical explanations for birth order effects seem to center on differences in the behavior of parents and in the home environment. Research findings typically show that parents instill high achievement standards in their first- and only-born children. This parental characteristic could account for much of the difference in accomplishment between first- and later-borns and for differences in volunteering for achievement-oriented tasks. It is probably also true that first- and only-borns are more consistently rewarded for attending to and being oriented toward others—perhaps because the oldest and only children, being first in line, will be most rewarded for seeking out the attention of parents. Even more important may be the fact that the absence of slightly older siblings to serve as behavioral guides doubtless forces the first- and only-borns to employ parents and other adults as their social models during early childhood, an act that can have profound effects on the individual. Since parents are widely discrepant in both age and ability, they are models whom the child cannot hope to emulate successfully. His failure to master the same tasks as the model may well result in a lowered opinion of his own ability. This argument is supported by the studies which have reported lower self-esteem among first- and only-borns. It follows that, if first- and only-borns lack peer models with whom they can favorably compare their own reactions and abilities, they should be less certain of the quality and appropriateness of their reactions in novel or stressful situations. The result of this uncertainty may be a greater need for social and emotional comparison of one's self with peers in anxiety-provoking situations, which in turn would account for the increased gregariousness of first- and only-borns under stress. The uncertainty of first- and only-borns about their reactions or abilities could also result in greater anxiety under trying circumstances. Considerable research evidence indicates that high levels of anxiety interfere with performance, a

*Perry, C. J. G., "Psychiatric selection of candidates for space missions." *Journal of the American Medical Association*, 1965, 194, 841-844.

finding which could account for inferior performance of first- and only-borns under high stress.

On the other hand, the child with a slightly older sibling can contrast his abilities and reactions with someone much closer in physical, social, intellectual, and sexual development than a parent. Such an individual should have a more accurate conception of his own abilities and of the appropriateness of his responses to novel situations. This could account for less anxiety and less need to affiliate under stressful conditions. It would appear that the differences between first- or only-borns and later-borns should be strongest in situations where the individual is uncertain about what he should feel, think, or how he should behave or perform.

One crucial test of the accuracy of some of these formulations is to look at the reactions of later-born children who are much younger than their older siblings. Such individuals should have less accurate social models than later-borns who are closer in age to their older brothers and sisters. If the theory is correct, these later-borns with a large gap separating them from their older siblings should behave more like first- or only-borns than like later-borns without such an age gap. Recent research supports this theory. In one study, the behavior of first-borns, later-borns less than two years younger than their next older sibling, and last-borns more than five years younger than their next oldest sibling were contrasted under stressful conditions.* The

CDR Scott Carpenter, astronaut turned aquanaut. All seven of original Mercury astronauts were first-borns.

*Miller, N., and Zimbardo, P. G., "Motives for fear-induced affiliation: emotional comparison or interpersonal similarity." *Journal of Personality*, 1966, *34*, 481-503.

results showed that first-borns and large age-gap last-borns were highly similar in their reactions; and that both groups were significantly different from small age-gap later-borns, thus supporting the social comparison hypothesis.

It seems that the most parsimonious explanations for widely observed birth order phenomena are based on different experiences in childhood. Greater motivation for achievement and more pressing needs for social comparison seem to account for many of the observed differences between first- or only-borns and later-borns. At present, though, any theories concerning this phenomena must be evaluated as *not proved.* The importance of birth order effects and the increasing amount of research that shows consistent results give reason to hope that order and coherence can be brought to this perplexing area.

Investigation of the effects of birth order forms part of a research area aimed at utilizing biographical information in the screening, selection and placement of men. While it is obvious that experiences forming the life history are relevant to success or failure in subsequent endeavors, particularly in stressful environments, psychologists are only beginning to understand and appreciate the important variables and their specific relevance. In order to utilize this type of information with maximum effectiveness, understanding of the conceptual and theoretical importance of relevant variables in the life history and in adjustment to a variety of environments is necessary. The basic aim of psychology is to specify with increasing precision the lawful nature of individual and group behavior. The effects of birth order on later behavior and adjustment appear at this time to have potentially profound implications for our understanding of human behavior.

Dr. Friedman Receives Rockefeller Public Service Award

The 1967 Rockefeller Public Service Award in the field of Science, Technology and Engineering has been awarded to Dr. Herbert Friedman, superintendent of the Atmosphere and Astrophysics Division of the Naval Research Laboratory. Dr. Friedman, who is also the Chief Scientist of the Hulburt Center for Space Research at NRL, has served 27 years as a career scientist with the Navy. He was honored for his experiments in rocket astronomy, his work in the satellite program at Wallops Island, and his training of physicists at the Hulburt Center.

The Rockefeller Public Service Awards were conceived and financed by Mr. John D. Rockefeller, III, to bring to public attention the high calibre of men and women in the federal career service. The awards are the highest privately sustained honor awards accorded government employees.

The award was presented at luncheon ceremonies in Washington, D.C., on December 6, 1967 at the Washington Hilton Hotel.

The Rewards of Residency Operation

Gerald W. Bowers
Office of Naval Research Resident Representative
Minneapolis, Minnesota

After 11 years' experience, it is the opinion of the author that serving as an Office of Naval Research Resident Representative is one of the most interesting, challenging, and rewarding careers in the federal civil service today. Contacts with other Resident Representatives indicate that they agree with this opinion.

There are several factors which contribute materially to job stimulation. Perhaps the most important is the close association with a wide variety of progressively dynamic and exciting research projects. The Minneapolis Residency has been most fortunate in this respect. A number of these research projects are described in this article.

A second factor is the frequent contacts that are made with scientists, university officials, and procurement officials of various government agencies. Although ONR ResReps were formerly primarily engaged in administering only ONR and Navy bureau contacts, that is no longer the case. In the Chicago Branch Office area, at least, a significant effort is devoted to administering contracts of other government agencies, including the Army, the Air Force, and the National Aeronautics and Space Administration. In this effort, it is the duty of the ResRep to apply the principles of contract administration to best meet the objectives of each procurement.

Other factors are the close relationships ResReps maintain with public relations media, including representatives from TV, radio, wire services, newspapers, and national magazines; and the feeling of achievement gained when one's efforts in obtaining excess equipment result in substantial cost savings to the government.

Balloon Capitol

The Minneapolis area is often referred to as the "Balloon Capitol of the World." The late Professor Jean Piccard of the University of Minnesota was the first to experiment with balloons made of plastic materials. Subsequently, four of the major companies which manufacture and launch plastic film balloons established their facilities within a 250-mile radius of Minneapolis.

In the early 1950's, a group at the University of Minnesota, under the direction of Dr. E. P. Ney, conducted a five-year study of the plastic balloon as a research vehicle. This balloon study program, which was jointly funded by the Army, Navy, and Air Force, was completed in late

1956. This project, which produced many advances in balloon theory, instrumentation, and launching techniques, still represents the most complete study of balloon dynamics and design ever conducted. This statement is supported by the facts that the 16 volumes of technical reports issued under this contract, referred to as "The Bible of the Balloon Industry," are still used as reference material by persons associated with balloons and balloon projects; and that, of the 23 invention disclosures listed under the contract's final patent report, ten have been granted patents by the U.S. Patent Office, and almost all of them have been used frequently in actual practice.

Over the years, the research balloon effort has produced many fascinating projects, such as CORONASCOPE, SKYHOOK, WETFOOT, STRATOLAB, and STRATOSCOPE, in which plastic balloons have carried both men and instruments to high altitudes. Being contract administrator for such projects often involves constant association with scientists from all over the United States who come to the Minneapolis area for project coordination with balloon launching contractors. In this regard, many expeditions have been and are being made which involve the shipment of vast quantities of balloons, helium vehicles, instruments, and launching gear to such sites as Canada, Australia, Africa, India, Alaska, South America, *etc.* These shipments, in turn, involve the countless logistics of timely schedules, mode of shipment, bills of lading, export restrictions, customs clearance, and return arrangements.

Sometimes a bit of humor is associated with these expeditions. In 1962, Dr. E. P. Ney led a group from the University of Minnesota to Mexico to study the zodiacal light during the solar eclipse of February 4. A balloon-borne shutterless camera that would rotate slowly when the balloon reached its maximum altitude had been devised to record this light. Since the recovery of these balloon-launched cameras was vital to the project's success, each carried a message with return instructions and an offer of a reward. The message requested that the package be delivered to the office of the American Consul at Monterrey, Mexico. For each package delivered in person, the finder would be reimbursed for his bus fare to Monterrey and given a reward of $40.00. The author had previously arranged for the University of Minnesota to deposit a sum of money with the Consul for this purpose. An alternate plan was for the finder to call or write the Consul, who would then send a car for the package.

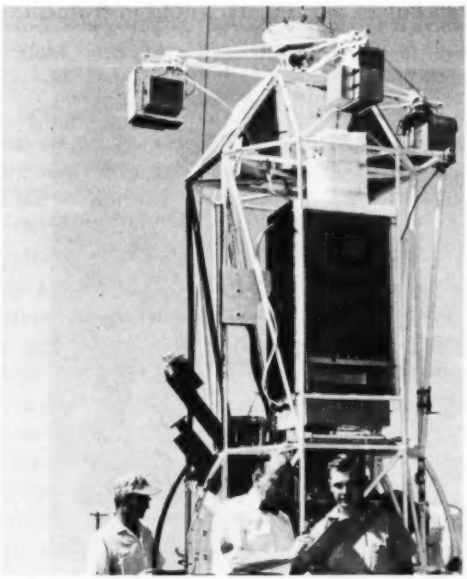
The first camera was recovered as the result of a telephone call which stated that it had been found near Maria del Ora over a month earlier by two Mexican laborers. Since they were unable to read its message, they had kept it in their house, never opening it, even though they reported it had "ticked" for five days. Finally, a friend assisted

them in having the return instructions and reward message interpreted.

Sometime later, a second package was recovered. An entire Mexican family marched into the American Consul's office with one of the cameras. Apparently, the head of the family gave a broad interpretation to the transportation offer.

A particularly exciting balloon project was CORONASCOPE, which utilized an instrument called the "Flying Coronagraph." With this device, it was possible to occult the sun, thus simulating a solar eclipse. In this manner, observations could be made to determine the size and distribution of matter which drifts into the upper atmosphere and causes sunlight to scatter. This series of flights was conducted for Dr. Gordon Newkirk of the High Altitude Observatory, University of Colorado. Although the first flight was manned by famed balloonist Malcolm D. Ross, as pilot, and Robert H. Cooper, of the observatory, as observer, the rest were unmanned. All were conducted in the Minneapolis area.

A good deal of public relations work was connected with the balloon projects. For example, Project STRATOLAB, a series of high-altitude manned balloon flights, had a great appeal to the public. Project STRATOSCOPE, a balloon-borne telescope, and CORONASCOPE, mentioned above, also had tremendous followings. The ResRep provided news releases to the news media and often accompanied the tracking crews to perform public relations duties at the launch site.



ResRep Bowers (left) consults with Dr. Newkirk on Project CORONASCOPE. The coronagraph, which could occult the sun, can be seen in the background.

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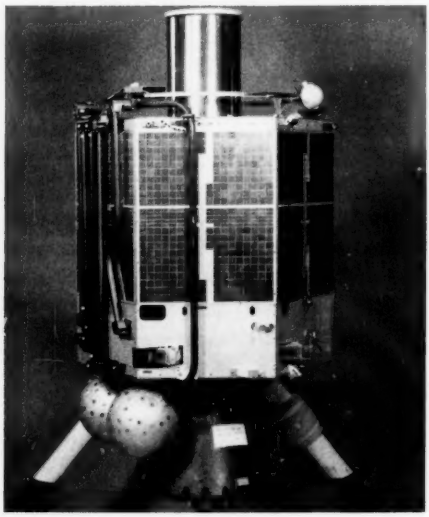
The INJUN Satellite

ONR's support of the University of Iowa's cosmic ray program, which is directed by the internationally known Dr. James A. Van Allen, began in 1952. Early studies were accomplished with balloons and balloon-launched rockets called "Rockoons."

Since 1961, support has been extended to cover the design and construction of a series of satellites called INJUN (Iowa-born Dr. Van Allen preferred the name HAWKEYE. However, there was already a DOD project with a similar name.). These satellites have been used for studies of the Van Allen belts, auroras, airglow, and other geophysical phenomena. INJUN I was launched in June 1961; INJUN II was destroyed in the launch attempt in January 1962; INJUN III and INJUN IV were orbited in late 1962 and 1964 respectively; and INJUN V, now being constructed, is scheduled for launch in early 1968.

As the series became increasingly complex and costly, ONR began to seek other support sources. As a result, INJUN IV and INJUN V have received substantial support from NASA. Also, Dr. Van Allen is simultaneously directing other satellite projects sponsored by NASA. These are experiments connected with the Orbiting Geophysical Observatory, the Polar Orbiting Geophysical Laboratory, and the Interplanetary Monitoring Platform programs. Contract administration duties for the NASA contracts supporting these projects was assigned to the ONR ResRep.

Normally, a university is concerned only with the design and construction of individual scientific instruments. The experiment "package"



INJUN V spacecraft jointly sponsored by NASA Langley and ONR. Spherical objects are part of folding beam dipole antennas used for VLF (Very Low Frequency) detection experiment.

is then delivered to a government laboratory or a commercial firm for integration into the spacecraft, along with other research packages. However, in the case of INJUN IV and INJUN V, responsibility for design, fabrication, test, and integration of experiments for the entire spacecraft was assigned to the University of Iowa. In the INJUN V satellite, the university, in addition to having responsibility for the spacecraft structure, is preparing three experiments of its own and will integrate two others which will be received from the NASA Langley Research Center and the Air Force Cambridge Research Laboratories.

The INJUN IV satellite prompted an urgent need for a tracking station near the university's physics laboratories. ONR agreed with Dr. Van Allen that such an installation would be highly desirable. However, the estimated costs for such an undertaking were prohibitive: informal estimates from qualified suppliers ranged from $250,000 to $300,000.

As an alternate solution, personnel from the university's Physics Department calculated how much it would cost if the university designed, constructed, and outfitted the station with ONR's assistance in obtaining available surplus equipment. Preliminary estimates were so encouraging that the project was begun. The ResRep was to act for ONR.

The first step was to determine the site location. The university owned a parcel of land about 12 miles south of Iowa City where an optical observatory was under construction. The land was the highest point in the county—thus, it was ideal for the tracking station antenna. Also, because contractors hired for the observatory installation already had their heavy equipment and crews on site, they were able to excavate; construct concrete fittings, slabs, and sidewalks; install electrical connections; and perform other services essential to the antenna project more economically. Thus, besides saving the cost of land rental or purchase, the choice of site significantly lowered construction costs.

The 28-foot antenna "dish" and tower were obtained from a supplier at half price: it seems that the unit was from a production "overrun" on a large government order. One of the largest single cost-saving factors, however, was being able to obtain a surplus Mark 37 gun mount from the Naval Ammunition Depot, Crane, Indiana. This gun mount was obtained with the assistance of the ONR Property Branch. Also, the ONR ResRep obtained metal plate, bars, angle and various other material from General Service Administration surplus stocks. Machining for the turntable platform and related components was done by the Physics Department's machine shop.

Another large saving resulted by having university personnel design, machine, and assemble the dish feed mechanism or "balins." Finally, the controls, cable installation, instruments, receivers, and miscellaneous assemblies were all installed by university technicians and

supervised student help. The total cost for the complete tracking station was approximately $78,000, or $170,000 less than the lowest quoted commercial estimate.

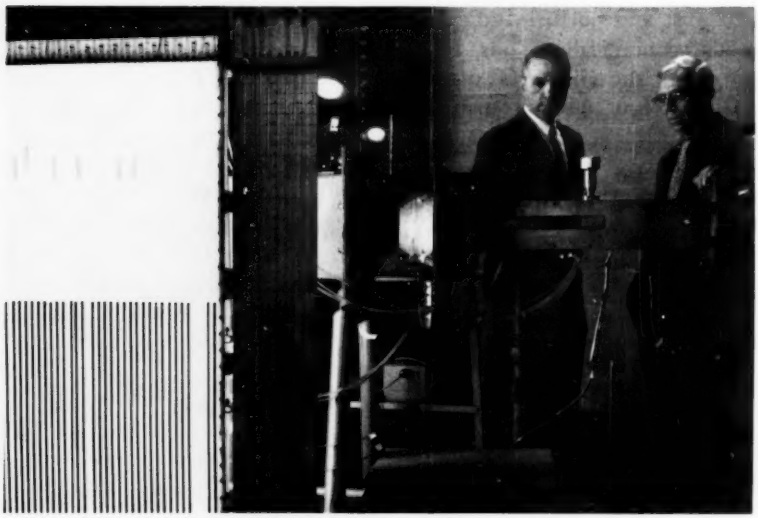
Other Research Projects

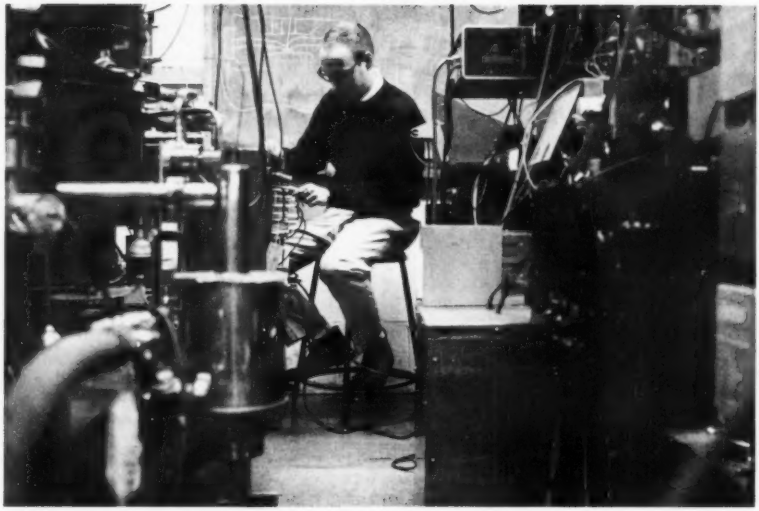
There are many other diverse research programs for which the author has the privilege of acting as contract administrator. A few of these programs are described in the following paragraphs.

Dr. E. R. G. Eckert, who has been a leader in the field of heat transfer for over 30 years, and Dr. Ralph Goldstein are conducting research in "film cooling" at the University of Minnesota under ONR sponsorship. Briefly, in many current engineering applications, a secondary fluid is injected between a wall or solid surface and a hot gas stream flowing over that surface. The coolant gas, which is injected through slots or rows of holes, acts like an insulator in that it decreases the heat transfer between the gas and solid. This film cooling process is being widely used to protect the structural elements of combustion chambers and after-burners in gas turbines and jet engines. There are many other practical applications for this process.

Dr. Robert G. Morris, of the South Dakota School of Mines and Technology, Rapid City, S.D., is performing measurements of thermal conductivity of semiconductors. Although initial measurements were made at room temperatures, his work has recently been expanded to

Dr. E. R. G. Eckert (right) and Dr. Richard Goldstein run "film cooling" experiment using supersonic wind tunnel and manometer bank





Graduate student Hohlfelder operates experiment on double-focussing mass spectrometer at University of Minnesota

cover research at lower temperatures. Eventually he desires to obtain data with temperatures as low as 4° Kelvin.

Dr. Morris' project, which is supported by ONR, is indicative of his institute's desire to play a greater role in basic research. The School has contributed significantly to the project by purchasing two major pieces of equipment—a nitrogen liquifier and a helium liquifier—and by providing a completely remodeled, air-conditioned laboratory in which to conduct the research.

Under the direction of Dr. A. O. C. Nier, the University of Minnesota has been conducting a research program in precision mass spectroscopy (Dr. Nier is well remembered for his part in the discovery of Uranium 235.). His group has developed a series of high resolution double-focusing mass spectrometers, a development which, together with special techniques employed by the research personnel, has enabled compilation of tables that reflect high precision measurements of the atomic masses of most stable isotopes. In addition, the research group has developed a tandem double-focusing mass spectrometer which is capable of measuring larger isotope ratios than conventional mass spectrometers can.

A third area of research in this program is concerned with rare gas analysis in meteorite samples. Dr. Nier's unique laboratory set-up, which employs three mass spectrometers and utilizes special techniques to separate the rare gases, permits great accuracy in determining isotope composition and in making abundance measurements.

Professor Olson and student assistants prepare to release small plastic balloon for air-earth current density measurements at Duluth, Minnesota.

Professor Donald Olson, of the University of Minnesota Branch at Duluth, Minnesota, is conducting an interesting research program in the field of atmospheric electricity. His project includes the utilization of "electric field mills" equipped with signal amplifiers and Esterline-Angus recorders which are located at Duluth, Bemidji and Warroad, Minn. (near the Canadian border); Ft. Churchill, Manitoba, Canada; and several other sites. Thunderstorm activity around the globe acts as a main generator to charge up the ionosphere to high voltage. Also, evidence of auroral activity working as such a generator was advanced by Dr. George Frier of the University of Minnesota in 1961. Professor Olson is making measurements of the atmospheric potential gradient, polar conductivity, and the air-earth current density associated with these charged-up conditions. Simultaneously with the electric field mill recordings, he uses small balloons outfitted with "electrometers" to make soundings at various locations in the United States and Canada.

A Helium Breakthrough

To illustrate just how varied the tasks of a ResRep can be, it may be interesting to include the story of the "helium breakthrough."

As can be imagined, a great deal of helium gas was needed for the balloon program and for various other laboratory research projects. This helium is shipped from the Bureau of Mines' extraction plants in Texas and Oklahoma in special railway cars—long high-pressure

cylinders which are manifolded together—which are owned by the Bureau.

For years the helium was transferred from the railway cars to special helium trailers which, in turn, were used to deliver the helium to the balloon launching sites, laboratories, *etc.* However, this procedure often resulted in lengthy delays: one or more railway cars were sometimes sidetracked for long periods at Minneapolis until the car or cars could be emptied. To avoid these delays, some thought had been given to constructing a permanent-type storage facility. However, getting funding for such a project was doubtful.

In mid-July 1962, the Bureau of Mines established the policy of charging $25.00 per day demurrage for each helium tank retained beyond 48 hours by the consignee. This policy meant—based on data from helium usage experience—that ONR would have to pay anywhere from $15,000 to $23,000 per year for demurrage charges. Thus, construction and operation of a helium storage facility was no longer merely desirable—it was imperative.

Meetings between the Commanding Officer of the Army Ammunition Plant near New Brighton, Minnesota and the ResRep ultimately resulted in a lease agreement between ONR and the Army. Consequently, personnel of the ONR Property Branch arranged for the transfer of 85 81-ft-long, 5.2-ton helium storage cylinders from Tillamook, Oregon. Shipment of these cylinders, which had been declared excess to the Navy's needs, was indeed a large undertaking. However, after some negotiation, the railroads agreed to provide special shipment rates.

Since General Mills, Inc., of Minneapolis, had been under contract to ONR to receive and distribute helium, that firm was selected to design and construct the proposed helium storage facility. A limited number of subcontractors were utilized in this operation. Also, Mr. T. E. O'Malley, a General Mills employee, devised an ingenious but inexpensive method of hydrostatically testing and purging the 85 large storage cylinders. This system, which utilized General Mills' laborers, resulted in a saving of more than $35,000.

During the course of this project, the ResRep, in addition to acting as contracting officer, coordinated efforts concerning shipments, bids, subcontract procurement, labor rates, contract construction classes, cost, *etc.* The total cost of construction was approximately $73,000. For purposes of comparison, the lowest commercial bid for doing such a job was over $194,000. The system can rapidly unload cars, store one million cubic feet of helium, and efficiently fill helium trailers and cylinders as needed for research projects. Needless to say, the ResRep derived great satisfaction in participating in a project that resulted to such substantial savings to the government.

Conclusion

This article attempts to give some idea of the great diversity of duties performed by the ResRep, and the varied types of research programs that fall under his purview. Acting as contract administrator for these programs—many of which are making material contributions to scientific advances—is a stimulating and challenging task.

In closing, a few words should be included which reflect the coordination which exists between the ResRep and the Naval Research Reserve. In this regard, the ResRep assists in training programs dealing with contract work and occasionally meets with units located in his area. The purpose of such meetings is to acquaint Reserve Reservists with the latest developments in ONR operations and to advise them of the latest changes that affect contract administration.

NTDC Modifies Weapon System Trainer

CDR O. W. Sanders, Acting CO and Director, NTDC (right) and LT H. W. King, Pilot from NAS Key West with weapon system trainer

The F48 Weapon System Trainer, Device 2F55F, has recently been modified in-house by the Naval Training Device Center, Orlando, Florida in direct support of the Vietnam effort, and has been accepted for installation at the Key West Naval Air Station. The trainer will be used for proficiency and transition training.

Device 2F55F is a complex WST which simulates the operational characteristics of an F48 Phantom II, Fighter-Interceptor, All-Weather aircraft. The major aircraft systems simulated are the engines, communication-navigation system, radar, missile fire control systems, and flight aerodynamics system.

The device is housed in two mobile vans. The first van contains a 400-cycle AC computer and associated circuitry necessary for the tactics simulation. The second contains the trainee's compartment, instructor's station, and computer compartment.

A Review of the International Conference on the Mechanics of Composite Materials

Harold Liebowitz
Structural Mechanics Branch
Office of Naval Research

A low weight, high strength, high stiffness material which can be tailored to meet the structural requirement—this is what scientists and engineers in the field of materials and structures have been searching for perennially. The use of the multiphase—or composite—material promises to fulfill this need and open up broad new horizons in the field of structural engineering that cannot yet be fully envisioned.

Fabricating fibrous composites that have high strength-to-weight and stiffness-to-weight ratios is a task of utmost importance—with respect to both small-scale specimens that can be used to determine material properties and full-size structural elements. Thus, the problem of determining what factors influence the achievement of these high ratios is worthy of increasing effort—especially now when more and more emphasis is being placed on specific applications of composite materials. Also, it is important to learn how concentration and orientation of reinforcements influence strength and stiffness under various loading conditions, what needs to be done to tailor the material so that optimum performance can be achieved for a given requirement in a given structure, and how these materials can best be utilized to meet the requirements of a structural system.

To study these aspects of composite development, several hundred scientists and engineers from the United States and seven foreign countries attended the International Conference on the Mechanics of Composite Materials which was held in Philadelphia, Pennsylvania, May 8-10, 1967. This conference, the fifth in a continuing series on structural mechanics, was cosponsored by the Structural Mechanics Branch, Office of Naval Research and the Space Sciences Laboratory, General Electric Company. It provided a rare and unique opportunity for people from all over the world to exchange their ideas on composite development. Dr. Fred W. Wendt, Space Sciences Laboratory, and the author served as co-chairmen.

The conference was made up of four sessions: Structural Requirements and Applications, Micromechanics, Structural Mechanics, and Failure Mechanics. At the beginning of each session, a survey presentation was made which reviewed and analyzed work performed in the

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respective area. These surveys not only introduced the papers given on specific areas, but also served to put the status of the whole area of the mechanics of composite materials in proper perspective. Survey presentations were made by Professor Zvi Hashin of the University of Pennsylvania, Dr. John Hedgepeth of the Martin Company, Mr. B. W. Rosen of the GE Space Sciences Laboratory, and Dr. Stephen W. Tsai of Washington University. The papers that followed these presentations served to couple the structural requirements of a system, *e.g.*, naval aerospace or reentry, to past and present studies into the fundamental mechanical properties of both composite materials and structural elements made of composite materials, and into their behavior under various environmental conditions.

Structural Requirements and Applications

Dr. Peter King, Chief Scientist of the Office of Naval Research, served as chairman of the opening session—Structural Requirements and Applications. The presentations made at this session pointed out the need for both experimental and theoretical studies into the mechanics of composite materials. They further pointed out that investigations in the area of micromechanics, failure mechanics, structural mechanics, and environmental effects are necessary, not only from the standpoint of predicting properties, *e.g.*, strength or stiffness, of composites, but also that of determining how a material can be most efficiently tailored to meet a certain requirement for a given structural system.

Dr. John P. Craven, Chief Scientist of the Navy's Special Projects Office, outlined the Navy's requirements for composite material in the general areas of missiles, aircraft, surface craft, and deep submersibles. With respect to naval construction in general, he indicated that current fabrication techniques are moving in the direction of those used in the aerospace industry. With regard to missile systems, he pointed out the attributes of composite materials in solid propellants: the combustible composite structure has generally succeeded in meeting operational requirements of the system, while still maintaining favorable structural properties. Also, he discussed continuing research and development programs on reinforcing grains and the potential of tailoring structural characteristics by altering the reinforcement configurations.

CAPT Lawrence L. Jackson, Jr., Commanding Officer of the Navy's Atlantic Undersea Test and Evaluation Center, discussed material requirements for ship systems. He emphasized the necessity of viewing these requirements on a broad spectrum, including the determination of long-range objectives and operational requirements, the definition of the ship system requirements, and the determination of the characteristics that the structural material must possess. He pointed out that

The conference provided an opportunity to exchange ideas on composite development

the progression of steps from long-range requirements to the selection of specific material systems would involve a great deal of communication among those concerned.

CAPT Samuel R. Heller, Jr., Director of the Hull Systems and Weapons Support Division, Naval Ship Engineering Center, dealt more specifically on the use of composite materials in the shipbuilding industry. He outlined the past, present, and future applications of glass-reinforced plastics in surface and submersible craft, and pointed out that these materials are already the primary structural materials for boats up to 60 feet in length. He also discussed the advantages and disadvantages of using glass-reinforced plastic composites in ship hulls for minesweepers, landing craft, and hovercraft; superstructures; piping; and hydrofoils.

Mr. Herbert S. Schwartz, Air Force Materials Laboratory, Wright-Patterson Air Force Base, pointed out that, although the early use of composites was in components with nonstructural functions, reinforced plastics are now being used in such highly stressed components as propeller and helicopter rotor blades. He added that although the use of high modulus fibers such as boron showed great promise in further structural applications, the lack of adequate design data presented a serious problem.

Mr. Richard R. Heldenfels, Chief of the Structures Research Division, NASA/Langley Research Center, summarized the applications of filament-reinforced composites in space vehicles and pointed out that the ability to tailor material properties is a great advantage for structural engineers.

Micromechanics

Professor Daniel C. Drucker, Engineering Division, Brown University, chaired the session on Micromechanics, which dealt with studies into the micromechanics of composites and the means of establishing fundamental properties of such materials. A few of the speakers at this session were: Professor August J. Durelli, Catholic University of America, who described experimental work being done in two and three-dimensional photoelasticity relating to a fiber-reinforced transparent matrix; Professor George Herrmann, Northwestern University, who discussed work being done to establish an "effective stiffness" of composites under dynamic loading conditions; and Professor Severino L. Koh, Purdue University, who reviewed continuum theories for composite materials, taking into account the characteristic microstructure of the material.

Structural Mechanics

The session on Structural Mechanics, which was chaired by Dr. Nicholas Perrone, Structural Mechanics Branch, Office of Naval Research, was concerned with the structural performance of composites. This particular area couples studies into the mechanics of composite materials with specific applications. For example, Professor Ulrich Hütter, Technical Institute, Stuttgart, Germany, discussed the optimization of shell structures under various loading conditions.

Also at this session, Mr. Kenneth Hom, Supervisory Structural Engineer at the Naval Ship Research and Development Center, Carderock, discussed the potential of reinforced plastics in deep-diving submersibles and pointed out that such materials are particularly applicable in this area because of the extremely high strength-to-weight ratio required in light-weight vehicles at depths exceeding 20,000 feet. He said that although the Navy is currently testing thick-walled cylinders of unstiffened glass-reinforced plastics, future needs will probably render glass reinforcement inadequate, making it necessary to use carbon fibers as the reinforcing material.

Failure Mechanics

The session on Failure Mechanics was chaired by Dr. George R. Irwin, Supervisor of the Mechanics Division, Naval Research Laboratory. A number of interesting papers were presented at this session, including three by foreign authors: Dr. George A. Cooper, University of Cambridge, England, who spoke on fracture mechanics of notched fibrous composites; Professor Sol R. Bodner, Technion-Israel Institute of Technology, who described experimental work on the dynamic

strength of composites; and Professor Kozo Kawata, University of Tokyo, who discussed the stability of laminates. In this latter regard, Mr. Phillip W. Mast, Mechanics Division, Naval Research Laboratory, also presented a paper on the fracture of laminates.

A highlight of the conference was the International Forum, which was held on Monday afternoon, May 8. Composite experts from six foreign countries presented summaries of research and development work being done in their respective countries.

The speakers at this conference represented a broad spectrum of scientific and engineering disciplines. However, in spite of their wide range of interests, conference attendees generally agreed that there were a number of problems that must be solved if composites are to achieve their full potential. These problems include:

- Development of reliable non-destructive testing techniques;
- Development of improved methods for quality control in fabrication;
- Development of improved design data;
- Development of improved test techniques to determine basic properties;
- Development of joint and penetration procedures; and
- Need for more research into the basic mechanisms of composite materials (micromechanics).

In conclusion, it is felt that the outstanding properties of composites, *e.g.,* high strength and stiffness, low density, ease of formability, *etc.,* will have a dramatic, if not revolutionary, effect on structures in the years to come.

Oceanographers Test Food Values in Sea

Scientists of the U.S. Naval Oceanographic Office, Suitland, Maryland, are presently testing a device which automatically analyzes the nutrient values of sea water while a ship is underway. Hitherto, such experiments were either conducted as hand operations, or by returning samples to a shore-based lab for analysis.

Through information gained from these analytical processes, scientists will be able to make more accurate forecasts of the presence of large schools of fish. Since fish feed upon minute organisms such as plankton, it can be predicted that sea water containing large amounts of such tiny animal life will support large numbers of fish.

NOO scientists advised that the automated system would test samples of sea-water for three types of chemicals: nitrates, silicates, and phosphates. Plankton usually exists where phosphates are available.

It is expected that a prototype of the automatic food analyzer will be placed on an oceanographic ship at an early date. NOO scientists will man the device during a two-week trial run in the open seas.

Radioisotopes – The Navy's Newest Power Source

Graham L. Hagey
Nuclear Engineering Division
Naval Facilities Engineering Command

The Navy—along with other government agencies—has a number of facilities scattered in remote, out-of-the-way areas throughout the world. These facilities, which include weather stations in polar regions, telemetering buoys in the ocean, and other special installations, require electrical power to perform their specific function. In some cases, personnel are assigned for the sole purpose of operating the machinery to provide that power; in others, relatively short-lived batteries—which must be replaced at frequent intervals—are used. The cost of maintaining these personnel and replacing batteries points out the need for a trouble-free, reliable, long-lived power source. The development of radioisotope thermoelectric generators should help solve this problem.

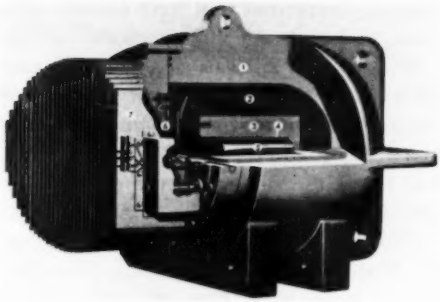
Such RTG's have been developed by the Atomic Energy Commission under its Systems for Nuclear Auxiliary Power (SNAP) program. The purpose of the program, which was begun in 1955, was to develop compact, lightweight, reliable nuclear electric devices for use in unattended operations in all environments—exactly what the Navy needed. A variety of radioisotopes, *e.g.*, strontium-90, are used as fuel for these generators. The heat generated from the slow radioactive decay of the fuel is converted directly into electricity through thermocouples which surround the fuel.

Actually, the Navy has used RTG's since June 1961, when a Navy experimental navigational satellite, launched from the then Cape Canaveral, became the first vehicle to carry a radioisotope power device into space. This historic, five-pound, three-watt nuclear generator (SNAP-3A) was installed to supplement the satellite's solar power.

The satellite was designed and developed by the Applied Physics Laboratory, Johns Hopkins Laboratory for the then Bureau of Naval Weapons. Not only was it the first to be powered by a nuclear power supply, but it was also the first to carry pick-a-back in tandem two other satellites—one developed by the Naval Research Laboratory, Washington to measure solar radiation and the other developed by the State University of Iowa to measure the radiation of the Van Allen Belt. Currently the oldest operating U.S. satellite, it is still sending intermittent signals to tracking stations around the world.

LCG-25A Generator Details

① *Shield*
② *Insulation*
③ *Inner shield*
④ *Fuel capsule*
⑤ *Radioisotopic fuel*
⑥ *Thermoelectric couple assembly*
⑦ *Radiator fins (aluminum plate)*



A second, similar Navy satellite with the same type of nuclear generator was launched in November 1961 but failed in orbit in July 1962. Two more Navy navigational satellites were launched in 1963 from Vandenberg Air Force Base, California. They were equipped with similar, but larger, generators developed by AEC.

The Navy is also using RTG's in terrestrial and ocean situations. Most of the generators being used in this area belong to AEC's SNAP-7 series, and are prototype RTG's presently on loan to the Navy. They are of similar thermoelectric design, use strontium-90 (in a relatively insoluble titanate form) as the heat source, and generally have radiation shields of depleted uranium.

Land and sea applications include unmanned weather stations, seismic stations for use in remote or hard-to-reach areas, navigation aids for use by ships and planes, ocean-bottom signaling devices, and oceanographic instrumentation.

SNAP 7-C, a ten-watt generator, is being used to provide power to an unattended weather station in Antarctica. It was installed by the Navy on Minna Bluff, 700 miles from the South Pole, in February 1962 and is still operating. The generator, converter, storage battery, and the station's electronic equipment are enclosed in an eight-foot high, three-foot-diam steel cylinder and buried in the snow. Only the whip antenna and weather-sensing instruments are exposed. The waste heat from the generator keeps the temperature of the buried equipment nearly constant, thus preventing it from freezing, a common failing of battery-operated stations in polar regions.

To supplement other weather data sources, the Navy has been using automatic weather stations mounted in small barges moored at sea. Such stations, part of the Navy's NOMAD (Navy Oceanographic and Meteorological Automatic Device) system, measure and transmit air temperature, barometric pressure, wind velocity and direction, *etc.* SNAP-7D, a 60-watt generator, was installed in a NOMAD weather station in the Gulf of Mexico in January 1964 and has been continuously operating ever since. This prototype system has been used to obtain

data on hurricanes that have caused damage along the Gulf of Mexico coast, and to power a navigational beacon.

SNAP-7E, a six-watt generator, is powering an experimental Navy underwater navigational beacon at the Bermuda underwater acoustic range. The thermoelectric generator and other equipment was housed in a vessel made to withstand tremendous pressure and moored 15,000 feet below the surface of the ocean in July 1964. A navigator can use this beacon in the same manner he uses a radio beacon or lighthouse.

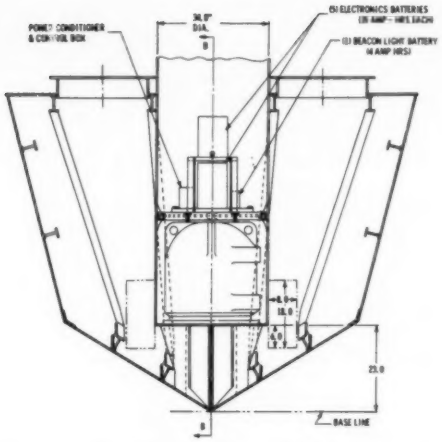
Finally, LCG-25A, a 25-watt generator, which was manufactured by the Martin-Marietta Corporation for the Navy, is being used to power an oceanographic telemetry system at Fairway Rock, Cape Prince of Wales, Alaska. This system, which is being used to measure water mass flow and temperature, was installed in August 1966.

Projected Navy Applications of RTG's

In May 1966 the Chief of Naval Material designated the Naval Facilities Engineering Command as coordinator for Navy development and use of RTG's. Also, the CNM Radioisotope Committee, consisting of representatives from interested Systems Commands and Navy laboratories, was established to provide advice and assistance.

NAVFAC, in its role as coordinator, is currently obtaining, through loan and procurement, six small (100 milliwatt to 25 watt) strontium-90 titanate RTG's for laboratory and undersea test, evaluation, and operational use at the Naval Civil Engineering Laboratory, Port Hueneme, California. This testing program will qualify the generators for long duration (beyond 2 years), unattended operation at seawater depths of

NCEL will conduct a testing program to qualify RTG's for long-term, unattended operation at great ocean depths



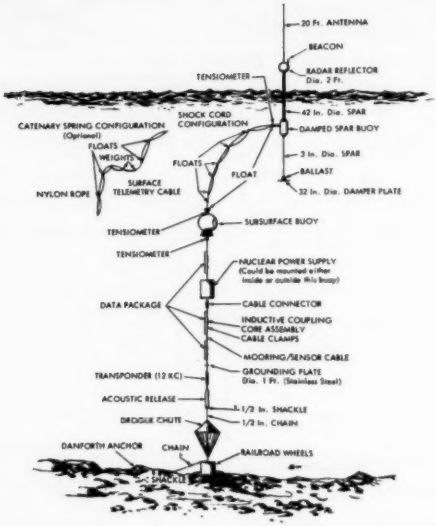
LCD-25D RTG's will be used in NOMAD weather buoys

several hundred feet. Subsequent operational use with submersible test units will extend this depth to several thousand feet. Operational use will be in conjunction with position-marking acoustic pingers and transponders. A strontium-90, titanate RIPPLE III thermoelectric generator, which is being loaned to NCEL by the United Kingdom Atomic Energy Authority, will be included in this test program.

The Naval Air Systems Command, through NAVFAC, is procuring three radioisotope-powered (LCG-25D) NOMAD weather buoys from Martin-Marietta Corporation. It is anticipated that the buoys will be placed in field service in 1968.

The Naval Electronics Laboratory (NEL), San Diego, California, has requested NAVFAC assistance in procuring a 25-watt RTG to be used in a 1968 underwater sound propagation mission. The RTG-powered transmitter and a passive receiver array will be submerged at a depth of approximately 2,000 feet about 300 miles apart along a water path with a mean depth of 18,000 feet. Delivery of this RTG, anticipated for April 1968, will be made to NCEL for one or two months' electrical testing in conjunction with the NCEL RGT test program mentioned above. When the testing has been completed, NCEL will assist NEL with system engineering and undersea emplacement.

The Naval Oceanographic Office has requested NAVFAC assistance in procuring and emplacing a 25-watt RTG for use in an oceanographic-buoy interrogation, recording, and location system (IRLS). This system will be used in conjunction with the National Aeronautics and Space Administration's NIMBUS satellite program. The RTG-powered IRLS buoy platform will transmit oceanographic data to NIMBUS satellites for subsequent transmittal to a central ground control and data acquisition station. Emplacement of the RTG-powered platform is scheduled for March 1968.



The RTG to be used by NAVOCEANO in the oceanographic-buoy interrogation, recording, and location system (IRLS) will be leased from NAVFAC

In addition, a Navy Specific Operational Requirement (SOR) exists for a kilowatt(e) radioisotope system to be used in the following potential missions:

- Terrestrial bases—primary and auxiliary power;
- Remote communication facilities, navigational aids, and weather stations;
- Electrical power and heat for Antarctic stations; and
- Undersea applications, both manned (such as Sealab habitat) and unmanned (such as underwater sound propagation).

To provide for increased Navy use of radioisotope power devices, NAVFAC has developed a plan whereby RTG's can be leased by mission users. After initial procurement has been made, RTG's will be made available to mission users (such as NEL and NAVOCEANO) at a yearly lease cost of about $10,000. On this basis, the RTG can compete favorably—in terms of "cost effectiveness"—with batteries. After the mission is completed, the RTG's will be returned for refurbishment (fuel capsule, thermoelectric modules, electronics, *etc.*) and leased to another mission user. In this regard, the IRLS RTG mentioned above will be leased by NAVOCEANO on a lease basis from NAVFAC at a cost of $54 per kilowatt(e) hour.

Other potential Navy requirements for radioisotope power are currently being examined by NAVFAC. With increasing Navy awareness of the mission advantages offered by radioisotope power devices, and with the advent of more efficient devices, it is believed that the Navy "market" will greatly increase in the next few years.

Multi-Purpose Terrain Model for Amphibious Training

A unique 50 × 70-ft multi-purpose terrain model of a 7000 square mile area has recently been delivered to the Marine Corps Amphibious School, Quantico, Virginia. The model, which was developed by the Aero Service Corporation, Philadelphia under a study contract with the Naval Training Device Center, Orlando, will be used for training Marine Corps personnel in amphibious warfare doctrine, tactics, and techniques.

The multi-purpose model depicts four geographically diverse areas which are topographically typical of tropical, subtropical–Mediterranean, and subpolar regions: Danang, South Vietnam; Israel-Lebanon; Stavanger, Norway; and Sakhalin Island, Soviet Union. Yet, the component sections of the model are interchangeable to the extent that almost any geographical locale in the world can be represented.

The model, built on the scale of 1:7500, consists of more than 80 six-foot-square topographic sections and numerous island formations of various sizes and shapes. In addition, portable and maneuverable models of cultural, topographic, vegetational, and man-made features such as urban complexes, rivers, orchards, shoals, buildings, *etc.*, are furnished. The model's six-foot sections, which are made from fiberglas and reinforced with epoxy resin on 1/2-in. plywood frames, can support up to 250 pounds. Thus, an instructor can traverse the surface at will when arranging these models.

The peripheral and internal interchangeability of the terrain model sections is made possible through the principle of profile identity. Eighteen sections of the model's hinterland have different internal topography but uniform profiles. Thus, they are completely interchangeable with all contiguous sections regardless of the manner in which their edges are mated. This permits the military planner to construct any possible combination of topographic formations as an aid in amphibious combat operations planning. For night tactical training capability, ultraviolet light can be used on luminescent-treated coastlines, mountain-tops, roads, and rivers.

The Aero Service Corporation also built a 3 × 4-ft table-top version of the terrain model, complete with all cartographic features and logistical models, which enables the instructor to plan tactical lessons with small in-hand materials. After the instructor has planned the lesson on this replica, assistant instructors and training technicians can, by noting model section numbers and other information, readily duplicate the tactical situation on the terrain model.

Research Notes

Sixteen Universities to Receive $7,000,000 From Navy Under Project Themis

Contracts totaling about $7,000,000 have been awarded by ONR to 16 universities which were previously selected to carry out the Navy portion of DOD's Project Themis. The objective of the Themis program is to develop new centers of excellence capable of solving future national defense problems as well as to stimulate research programs at universities which have not previously participated to a significant extent in defense research programs.

The contracts awarded by ONR will represent the first installment of funds for what are intended to be long-range research programs at these universities. It is anticipated that funds to continue the programs will be available in subsequent fiscal years. Project Themis has been inaugurated with a total of 50 research programs monitored by the Navy, Army, Air Force, and the Advanced Research Projects Agency. New programs will be started in successive fiscal years. All Themis programs are unclassified.

The university programs selected for Navy sponsorship, the initial funds allotted, and a brief description of the research to be conducted are listed below:

Arizona State University—Human Performance in Isolation—$380,000

This program is aimed at developing and operating a research facility to investigate animal and human performance in unusually stressful environments, with emphasis on the underwater environment. A high-pressure chamber capable of simulating depths to 2000 feet will be developed. The object is to pave the way for Navy free swimmers and divers to operate at great depths.

Florida State University—Geophysical Fluid Dynamics—$600,000

This program is aimed at developing a university center in geophysical fluid dynamics. In science, a fluid is any material that flows, including air and other gases. Studies will be made of ocean currents and waves, the formation of clouds and hurricanes, global circulations, and planetary atmospheres in an attempt to solve the intricate equations which govern the large scale flow of all fluids.

University of Hawaii—Astronomy Research—$350,000

Support is being provided for studies to be conducted at the university's Institute for Astronomy. Particular emphasis will be placed on the study of the sun, including the effect of solar activity on the earth's atmosphere. The ability to understand and predict solar activity is essential both for improved long-range weather forecasting and reliability of long-range radio communications.

University of Houston—Information Processing System—$400,000

This program is aimed at developing special programming languages for on-line computer systems. Such information processing systems utilize remote terminals connected to a central computer and operated on a time-sharing basis. This enables a user to carry on a dialogue with a computer rather than to laboriously process a complete program through the machine. The languages to be developed will permit broader and more sophisticated use of on-line computers by scientists and engineers relatively untrained in programming. This system will be particularly useful to Navy commands and laboratories for use in signal processing, ship and aircraft design, and general problem solving.

Iowa State University—Automatic Navigation and Control—$400,000

This program is designed to investigate the automatic navigation and control of manned and unmanned flight vehicles as well as associated technology in sensors.

University of Massachusetts—Deep Sea Submersibles—$360,000

This program, which deals with applied research and exploratory development in deep sea engineering, is aimed at developing new and improved materials and methods in deep sea submersible systems. The broad areas of investigation will include propulsion, materials, navigation and communication, structures, environment and hydrodynamics.

University of Minnesota—Gas Turbine Technology—$400,000

This study concerns the problem of heat transfer as it affects the efficiency of gas turbine engines. While an increase in temperature can improve the efficiency of the conversion of heat energy in the fuel into power, this has been limited by the ability of the material of the turbine blade to withstand heat. Techniques for cooling the turbine blade material to permit the use of higher temperatures will be investigated. Such techniques will be necessary in the development of supersonic aircraft as well as for developing advanced gas turbine engines for naval ships and surface craft.

University of Minnesota—IR Detector and Laser Technology—$380,000

This program is aimed at developing new technology in the use of lasers and infrared detectors. Both theoretical and experimental investigations will be carried out.

New Mexico Institute of Mining & Technology—Environmental Sciences—$406,000

This program is intended to advance knowledge of the electrification processes in the atmosphere associated with thunderstorms. A broad program of theoretical, laboratory and field investigations will be conducted. The objective is to achieve both thunderstorm predicting capability and to provide flight safety for naval aircraft.

University of New Mexico—Radiation Effects—$370,000

This program will be directed towards a study of the effects of nuclear and cosmic radiation on electronic devices. Such information will permit the development of solid state devices capable of operating even after lengthy exposure to relatively high levels of nuclear or cosmic radiation. The Navy is particularly concerned with the operation of electronics equipment aboard ships or aircraft in high radiation environments, such as would result in the aftermath of a nuclear explosion.

State University of New York at Buffalo—Environmental Physiology—$600,000

This program concerns the physiological response of man to unusually stressful environments, such as those encountered beneath the surface of the oceans at all possible levels of submergence. Included will be studies on free swimming, sealed-cabin conditions, high altitude and increased G-forces.

University of Notre Dame—Deep Sea Engineering and Aerodynamics—$400,000

This program, designed to develop new technology in deep-sea engineering, is aimed at providing a basis for the engineering of a new generation of high-speed, deep-ocean military vehicles. Special attention will be given to vehicular control, maneuverability, materials, structural strength, and communications.

Oregon State University—On-Line Computer Environmental Research—$580,000

This program is intended to develop techniques for using computers in the collection and analysis of oceanographic data on a real-time basis. A giant telemetering buoy moored in the ocean will transmit both oceanographic and meteorological data to shore.

The data will be used to develop a mathematical model to describe the energy exchange and other processes taking place within and above that section of the ocean where the buoy is moored. A hybrid analog digital computer will be used to compare the model with the actual data transmitted from the buoy making it possible to improve and perfect the model so that it conforms to the real environment.

Stevens Institute of Technology, Hoboken, N.J.—Nonlinear Physics of Polymers—$324,000

This program is aimed at developing the basic principles involved in the behavior of polymers and polymeric materials in actual processing, fabrication and utilization. The objective is to aid the development and use of plastics, rubber and fibrous materials in the manufacture of components for military systems operating in extreme environments, particularly where high strength and resistance to shock or high impact are required.

South Dakota School of Mines—Modification of Convective Clouds—$260,000

This program is aimed at determining how to modify or dissipate cumulus clouds and to develop techniques and instrumentation for accomplishing this. Means of modifying the weather can be of particular benefit to Navy surface ships and aircraft.

University of Tennessee—Dynamic Sealing—$300,000

A program of dynamic sealing research will be undertaken which will focus on the problem of effectively sealing openings around a rotating shaft or other moving parts. A major example is the main propeller shaft of a submarine. As submarines are designed capable of reaching greater depths, leaks could become critical. Other applications to be studied are advanced air breathing engines and pumps.

Texas A&M—Optimization Research—$400,000

This program is aimed at developing mathematical techniques for optimizing solutions to realistic engineering problems. The objective is to provide Navy engineers with a tool in the design of military systems which will permit a more precise determination of not only performance but also weight, cost, and reliability requirements.

Navy Hydrofoil Being Tested

The Navy's newest hydrofoil, the 71-ft gunboat TUCUMCARI, is currently undergoing an extensive series of tests in Puget Sound, near Seattle.

The gunboat, built and designed by the Boeing Company, Seattle, made its first flight on three thin, steel, wing-like foils. It achieves high speed by lifting its hull clear of the water, thus eliminating most water resistance. This foilborne flight, which gives the craft outstanding ability in rough water, is one of the hydrofoil's main advantages.

TUCUMCARI, designated PGH-2 (Patrol Gunboat-Hydrofoil) is the first of its kind in U.S. Navy history. It may be the forerunner of a fleet of small, swift, special-mission craft.

In foilborne operations, the gunboat's 3200 hp gas turbine drives a water-jet pump which sucks water through the rear foil struts and up into the pump and then "jets" it out through nozzles in the gunboat's hull. At speeds of more than 40 knots, the craft pumps 100 tons of water a minute. A smaller, diesel engine-powered water jet propulsion system is used for hullborne maneuvers.

A water jet has no complicated power transmission system as is required for propeller craft. Also, the lubrication and maintenance problems associated with the hundreds of moving parts of a conventional propeller system are eliminated. The turbine powerplant is coupled directly to the high-speed aluminum pump, which permits a compact installation.

The gunboat displaces 57 tons and has a 20-foot beam. The craft's hull and superstructure are made of aluminum. Foils and struts are of corrosion-resistant steel.

Although the gunboat is being tested initially without armament, it will carry a 40mm gun, an 81mm mortar and two sets of twin 50-caliber machine guns.

After the new hydrofoil is tested for several weeks on Puget Sound and in the Pacific, it will be delivered to the Navy. See cover photograph.

Unmanned Automated Deep Sea Buoy System Developed

An unmanned deep-sea automated buoy system which records oceanographic and meteorological data simultaneously has been developed by the Environmental Science Services Administration's Coast and Geodetic Survey. The system, known as ODESSA (Ocean Data Environmental Science Services Acquisition), is regarded as an outstanding advance in ocean engineering.

ODESSA measures the temperature, salt content, and depth of the water and the speed and direction of its currents, as well as barometric pressure, air temperature, and wind speed and direction.

The system consists of a number of buoys, each supporting a group of surface and subsurface electronic sensing packages. The data gathered by the sensors is telemetered to a central recording station (a console), either aboard a ship or on land. Each buoy also contains a magnetic tape recorder so that the data can be recorded at each buoy station as well as at the central recording site.

The system can accommodate up to ten buoys, each supporting several surface and subsurface sensor packages, with five sensors per package.

The data can be gathered at various depths in the ocean, and the buoys can be left unattended for weeks at a time. If necessary, they can be inspected and serviced. A lost buoy can be recovered by beaming in on its telemetry device. The system was designed so that other sensors can eventually be added to obtain additional data on the marine environment.

In addition to providing a valuable research tool for oceanographers, the ODESSA system has potential uses in studying pollution in harbors and estuarine waters, and in collecting data on the habitats of fish. It will play a major role in ESSA's investigations of the continuous exchange process which occurs at the interface between the air and the sea.

ODESSA, a highly advanced version of the TICUS (TIdal CUrrent Survey), has been under development by the Coast Survey for two years. TICUS measures only the speed and direction of the current.

Death Comes to Two Prominent ONR Leaders

ONR personnel were saddened by the sudden deaths of two previous ONR officials—Dr. Alan T. Waterman, the first Chief Scientist, and RADM Rawson Bennett II, Chief of Naval Research from 1955 to 1961.

Dr. Waterman, who died on November 30, was instrumental in developing an effective relationship between the Navy and the scientific community. In 1951, he became first Director of the National Science Foundation.

RADM Bennett, who died on December 7, served two terms as Chief of Naval Research. He was in charge of Operation Vanguard, the first U.S. venture into space.

On The Naval Research Reserve

NRRC 1-2 Receives Commandant's Trophy as Best Phased Forces Unit

Receiving trophies and awards is nothing new for NRRC 1-2, Providence, R.I. This company won the General Excellence Award for Research Units in 1964, and was runner-up for the award in 1965 and 1966.

Its latest trophy was the Commandant's trophy for Best Phased Forces Unit in the First Naval District for fiscal year 1967. It was presented by CAPT Berthrong, Chief of Staff, First Naval District on October 17 during ceremonies at N&MCRTC, Providence. The ceremonies were sparked by remarks from Rhode Island's Lieutenant Governor Joseph H. O'Donnell who cited the Naval Reserve's contribution to the defense posture of our nation as well as its integration into the community. NRRC 1-2 is commanded by LT Raymond B. Larter, USNR-R.

Research Reservists Participate in Yukon Studies

Two members of NRRC 1-7, Hanover, New Hampshire, recently returned from the Yukon area where they had participated in the Icefield Ranges Research Project during the summer. The project, which is supported by a National Science Foundation grant and sponsored by the Arctic Institute of North America, provides opportunities to conduct field research in climatology, glaciology, geophysics, geography, and physiology in the most extensively glaciated area on the North American continent.

LT Richard N. Ragle, USNR-R, of NRRC 1-7, is the Chief Scientist for the project. A Fulbright Scholar, LT Ragle received his master's degree from Dartmouth College after attending the University of Oslo and the Norsk Polar Institute. LT Ragle is no newcomer to the Arctic: he has performed research and rescue operations on the Greenland Ice Cap as well as on glaciers of the Alaskan coastal ranges. In his dual role as geologist and flier, he has made many glacier landings and takeoffs by both fixed-wing aircraft and helicopter. In 1958, after making two rescue expeditions on the Greenland Ice Cap, he was presented with the Exceptional Civilian Service Award from Mr. Wilber M. Brucker, the then Secretary of the Army. Also, he made a number of flight operations in the project's Helio Courier Aircraft at altitudes varying from 2,560 to over 12,000 feet.

The second member of NRRC 1-7, LCDR John P. Henry, MC, USNR-R, joined the Icefield Ranges Research Project to conduct

physiological research at high altitudes in cold regions. Dr. Henry studied the regulation of respiration at elevations from 8,500 to 17,500 feet. In New Hampshire, Dr. Henry is Chief of Research at the Veterans Administration Center in White River Junction and assistant Professor of Physiology at the Dartmouth Medical School.

A survey was commenced in 1961 of the St. Elias Mountains region of the Yukon area in order to locate a suitable base camp for the project. As a result, the Kluane Base Camp was established near the southern end of Kluane Lake adjacent to the Alaska Highway. Since the camp has its own airstrip, it is uniquely accessible by either commercial or private transportation. The project is further enhanced by the Helio Courier Aircraft and Polaris Snow Traveler which provide both logistics and oversnow mobility, thus enabling the central glacier camp to support far-ranging field parties. Also, since the nearness of the Alaskan Highway permits use of a highway bus to transport personnel and equipment, transportation costs are drastically reduced. By making such facilities and logistics available at such a low cost per man, the Icefield Ranges Research Project is aiding in the development of future scientists for the North American continent.

NRRC 4-1 Wins National Competition

This year's winner of the Research Reserve *Award for General Excellence*—Naval Reserve Research Company 4-1, Princeton, New Jersey—was announced by RADM T. B. Owen, USN, Chief of Naval Research, on November 20, 1967.

Nominations for the award, which is given to the most outstanding Research Reserve company, were submitted by Commandants of the Naval Districts. CAPT Edmund C. Reichard, USNR, was in command of NRRC 4-1 during Fiscal Year 1967. Presentation of the award is planned for early 1968.

Among the accomplishments of the 49-member Research Reserve company for Fiscal Year 1967 were the following:

Inspection Grade	3.83
Ready Reserve Status	94%
Drill Attendance	97%
ACDUTRA Participation	45%
Correspondence Course Completion	59%
Training Grade	3.79
Membership, Net Increase	+14

A panel was established to review the records, inspection marks, and other criteria on which the award is based, and to recommend the winning company. It was composed of the following officers: CAPT

D. D. Kilpatrick, USN, Director, Air Programs, Office of Naval Research; CAPT E. L. Huie, USNR, Assistant for Naval Reserve Policy, Office of the Assistant Chief of Naval Operations (Naval Reserve); CAPT J. E. Kennedy, USNR, Director, Naval Reserve Programs Division, Bureau of Naval Personnel.

Members of the panel which convened to designate the winner of the *Award for General Excellence* commented very favorably on the records of the other companies entered in the competition. These companies and their Commanding Officers for Fiscal Year 1967 are as follows:

1-2	Providence, R.I.	LT Raymond B. Larter, USNR
3-9	Upton, N.Y.	CDR Leonard A. Baker, Jr., USNR
5-12	Dahlgren, Va.	CDR Robert M. Fenn, USNR
6-3	Oak Ridge, Tenn.	LCDR Wimmer J. Leonard, USNR
8-13	Stillwater, Okla.	CDR Allen D. Tillman, USNR
9-4	Milwaukee, Wisc.	CAPT Robert E. Best, USNR
11-5	San Diego, Calif.	CDR Raymond D. Tuttle, USNR
12-6	Davis, Calif.	LCDR Charles L. Alward, USNR
13-6	Idaho Falls, Idaho	CAPT Thomas J. Wadsworth, USNR

Scripps Discovers Seamounts in Western Pacific

Two submarine volcanoes, or seamounts, were recently discovered and charted during the Scripps Institution of Oceanography's Nova Expedition to the southwest Pacific. The seamounts, which are considered to be among the largest yet discovered, have been named after two veteran marine technicians at Scripps—Fred S. Dixon and George W. Hohnhaus. Both men are members of the current Nova Expedition.

The two seamounts were discovered about 1200 miles southwest of Hawaii, 60 miles east of the International Dateline, and halfway between Midway Island and the Fiji Islands. They are both located in the same flat, abyssal plain, but are about 53 miles apart.

The Dixon Seamount, the taller of the two, was charted at 12°33.3′N and 179°3.8′W. It measures some 38 miles across the top and 13,200 feet high, rising from 18,000 feet to within 4800 feet of the ocean's surface. Extensive topographic and magnetic measurements of the Dixon Seamount were taken. It was traversed six times in order to obtain accurate measurements for charting its magnetic polarity. Using these measurements, it may be possible to determine when Dixon Seamount was formed, based on knowledge of changes in the earth's polarity millions of years ago.

The Hohnhaus Seamount was charted at 13°27.1′N and 179°10′W. It measures about 31.5 miles across and 12,400 feet high.

The 18th International Symposium on Turbulence of Fluids and Plasmas will be held at the Waldorf-Astoria Hotel, New York, N.Y., April 16-18, 1968. The symposium is organized under the aegis of the Microwave Research Institute, Polytechnic Institute of Brooklyn, and is cosponsored by the Air Force Office of Scientific Research, the Army Research Office, and the Office of Naval Research. Additional information may be obtained by contacting Mr. Jerome Fox, PIB Symposium Committee, 333 Jay Street, Brooklyn, N.Y. 11201.

Selected Contract Research Reports

The contract research reports listed below have been extracted from the U.S. Government Research & Development Reports 67, No. 20 and 21 of October 25, 1967 and November 10, 1967. Government agencies and their contractors who are registered with the Defense Documentation Center of the Defense Supply Agency may obtain *free* copies from the center at Cameron Station, Alexandria, Virginia 22314. Abstracts of the reports are found in USGRDR's No. 20 and 21.

For non-DDC users, most reports may be purchased from the Clearinghouse for Federal Scientific and Technical Information, Department of Commerce, Springfield, Virginia 22151.

AERONAUTICS

Integrated Electronic Vertical Display Research; United Aircraft Corp.; Wooding, Jr. and Simpson; AD-657 951

ASTRONOMY AND ASTROPHYSICS

Cosmological Element Production; CalTech; Wagoner; AD-657 969

Dimensions of Southern Planetary Nebulae; Dearborn Observatory; Henize and Westerlund; AD-657 979

Observations of Southern Planetary Nebulae; Dearborn Observatory; Henize; AD-657 981

Differential Rotation and the Solar Oblateness; Princeton U.; Dicke and Goldenberg; AD-657 986

Non-Axisymmetric Differential Motions in Galaxies Having Axisymmetric Mass Distributions; Chicago U.; Vandervoort; AD-657 386

ATMOSPHERIC SCIENCES

Cosmic Rays as a High-Energy Particle Source; CalTech; Cowan and Moe; AD-657 480

Iodine, Bromine, and Chlorine in Winter Aerosols and Snow From Barrow, Alaska; M.I.T.; Duce *et al;* AD-657 724

Lead and Halogens in Pollution Aerosols and Snow From Fairbanks, Alaska; M.I.T.; Winchester *et al;* AD-657 726

Coherence of Iodine and Bromine in the Atmosphere of Hawaii, Northern Alaska, and Massachusetts; M.I.T.; Winchester and Duce; AD-657 727

Geomagnetically Trapped Alpha Particles; Iowa U.; Krimigis and Van Allen; AD-658 340

BEHAVIORAL AND SOCIAL SCIENCES

A Plan for the Establishment of a Computer-Aided Instruction Research and Development Center; General Learning Corp.; Torr *et al;* AD-657 348

Undesirable Effects of Hypnosis: The Determinants and Management; Pa. Hospital; Orne; AD-656 970

What Must a Satisfactory Theory of Hypnosis Explain; Pa. Hospital; Orne; AD-656 972

The Theory and an Experiment on a Simple Fungus-Eater Game; Calif. U.; Toda and Miyamae; AD-657 058

Operant Conditioning of GSR Amplitude; Ind. U.; Helmer and Furedy; AD-657 173

Transfer of Training in Verbal Learning; Calif. U.; Postman; AD-657 179

The Chinese Communist Politburo and Its Operational Code: A Feasibility Study; Stanford; North; AD-657 249

The Constant Error in Amplitude Discrimination and the Inter-Stimulus Interval: A Re-Examination; Wash. U.; Ronken; AD-657 263

Systematic Biases in Eye Movement Latency Data; Wash. U.; Saslow and Saslow; AD-657 297

Effects of Components of Displacement Step Stimuli Upon Latency for Saccadic Eye Movement; Wash. U.; Saslow; AD-657 299

Latency for Saccadic Eye Movement; Wash. U.; Saslow; AD-657 300

An Experimental Critique of the Method of Constant Stimuli and Some Alternative Procedures; Wash. U.; Ronken; AD-657 301

Operant Control of Response Latency in Monkey: Peripheral vs Central Explanations; Wash. U.; Saslow; AD-657 302

Scoling Extravehicular and En Route Judgments of Automobile Speed; Wash. U.; Semb; AD-657 303

Further Research With Adaptive Tasks; Dunlap and Associates, Inc.; Kelley; AD-657 343

Conceptual Structure and Group Processes in an Inter-Nation Simulation. The Perception of Simulated Nations; Educational Testing Service; Driver; AD-657 350

Training, Tasks and Mediator Orientation in Heterocultural Negotiations; Ill. U.; Nayar *et al;* AD-657 353

The Law of the Sea: Offshore Boundaries and Zones; R.I. Univ.; Alexander; AD-657 985

Decision Making and Performance in Heterogeneous and Homogeneous Groups; Princeton U.; Stager and Kennedy; AD-657 625

Animal Psychophysics: An Examination of the Field; Wash. U.; Saslow; AD-657 626

Communication, Cooperation, and Negotiation in Culturally Heterogeneous Groups; Ill. U.; Fiedler *et al;* AD-657 630

Organizational Communication: A Bibliography; Rutgers; Voos; AD-657 647

The Effectiveness of Adjustment by Subclassification in Removing Bias in Observational Studies; Harvard U.; Cochran; AD-657 849

Conceptual Level as a Composition Variable in Small Group Decision-Making; Princeton U.; Stager; AD-657 850

Mental Test Theory. The Foundations of Mental Measurement Theory; Educational Testing Service; Lord and Novick; AD-657 868

Mental Test Theory. The Classical Test Theory Model; Educational Testing Service; Lord and Novick; AD-657 869 and 870

Mental Test Theory. Other Weak True-Score Models; Educational Testing Service; Lord and Novick; AD-657 871

Mental Test Theory. Validity and Test Construction Theory; Educational Testing Service; Lord and Novick; AD-657 872 and 873

Mental Test Theory. Some Latent Trait Models and Their Use in Inferring an Examinee's Ability; Educational Testing Service; Lord *et al;* AD-657 874

Mental Test Theory. Strong True-Score Theory; Educational Testing Service; Lord and Novick; AD-657 875

Parkinson's Law as a Goal-Setting Phenomenon; American Institutes for Research; Bryan and Locke; AD-657 893

Factors in Recovery From Performance Decrement: Activation, Inhibition and Warm-Up; Naval Training Device Center; Catalano and Whalen; AD-657 896

One-Trial Learning With Control of Item Difficulty; Wash. U.; Pizzuro and van Laer; AD-657 933

Conceptual Structure and Interpersonal Attraction; Douglass Coll.; Streufert *et al;* AD-657 942

The Experimental Analysis of Aggression; Western Mich. U.; Ulrich; AD-658 164

The Effect of Conceptual Complexity and Group Discussion on Risk-Taking and Judgmental Behavior; Princeton U.; Lamm; AD-658 187

Comparative Pronounceability Ratings (p) of 100 CVCs in Two College-Populations; Georgia U.; Noble; AD-658 282

The Psychological Impact of Social Change in the Philippines; HRB-Singer Inc.; McKendry *et al;* AD-658 338

The Role of Mass Media and Interpersonal Sources of Information in Directed Social Change: A Review of the Literature on the Philippines; HRB-Singer Inc.; McKendry and Parco; AD-657 683

A Community Development Rating Scale for Philippine Poblaciones; HRB-Singer, Inc.; McKendry and Parco; AD-657 684

The Spatial Structure of a Selected Interpersonal Contact: A Regional Comparison of Marriage Distances in India; Northwestern U.; Mayfield; AD-657 852

BIOLOGICAL AND MEDICAL SCIENCES

Inhibitors of NADH-ubiquinone Reductase From Mitochondria; Calif. U.; Salach *et al;* AD-657 899

The Semiconductive Properties of Lipids and Their Relation to the Electrical Conductivity of Lipid Bilayers; Mich. St. U.; Jendrasiak; AD-657 954

Immunichemical Studies on Blood Groups. The Nature of the Unsaturated Residue in Some Oligosaccharides Produced by the Action of Sodium Hydroxide-Sodium Borohydride on Blood-Group A, B, and H Substances; Columbia U.; Lloyd and Kabat; AD-658 082

Immunochemical Studies on Blood Groups. The Structures of Difucosyl and Other Oligosaccharides Produced by Alkaline Degradation of Blood Group A, B, and H Substances: Optical Rotatory Dispersion and Circular Dichroism Spectra of These Oligosaccharides; Columbia U.; Lloyd *et al;* AD-658 188

A Comparison of Invariant Residues in the Variable and Constant Regions of Human K, Human L, and Mouse K Bence-Jones Proteins; Columbia U.; Kabat; AD-658 235

Bering Land Bridge: Evidence of Spruce in Late-Wisconsin Times; Arctic Inst. of North America; Colinvaux; AD-658 298

Turbellaria of Northern Alaska and Northwestern Canada; Arctic Inst. of North America; Holmquist; AD-658 300

Manayunkia Speciosa Leidy—A Freshwater Polychaete Found in Northern Alaska; Arctic Inst. of North America; Holmquist; AD-658 304

Geographic Notes on the Barbados Malaria Epidemic; San Fernando Valley St. Coll.; Fonaroff; AD-657 691

Use of Germfree Animals in the Study of Dental Caries; Chicago U.; Orland *et al;* AD-657 859

Induction of Interferon by the Bour Strain of Trachoma'in Hela 229 Cells; Wash. U.; Jenkin and Lu; AD-657 709

Microbiological Studies of Aquatic Habitats of the Area of Inuvik, Northwest Territories; Arctic Inst. of North America; Boyd and Boyd; AD-658 302

Metabolic Effects of Hydroxyurea on BHK-21 Cells Transformed With Polyoma Virus; Columbia U.; Pollak and Rosenkranz; AD-658 408

Amino-Acid Uptake Compared in Motor Neurons, Spinal Cord Grey Matter, Muscle, and Liver; State Univ. of N.Y.; Ford and Rhines; AD-658 243

Aeromedical Monitoring of Naval Aviators During Aircraft Carrier Combat Operation; Dunlap and Associates Inc.; Austin, Jr. *et al;* AD-657 987

Holothurians of the Genera Elpidia and Kolga From the Canadian Basin of the Arctic Ocean; U. of S. Calif.; Agatep; AD-657 506

Visual Discriminations of a Subject With Acquired Unilateral Tritanopia; Columbia U.; Graham *et al;* AD-657 310

Comparative Lipid Composition of Psittacosis and Trachoma Agents; Wash. U.; Jenkin; AD-657 493

Dynamic Behavior of Eye Globes; Stanford; Tuffias and Anliker; AD-657 382

Studies Related to an Early Detection of Toxic Effects of Organic Chemicals; Kansas U.; Lal; AD-657 252

CHEMISTRY

Deuterium Isotope Studies on 2,3-Dicarbahexaborane (8); Calif. St. Polytechnic Coll.; Spielman *et al;* AD-657 174

Boranes as Carbonium Ion Analogs; Akron U.; Ramsey; AD-657 254

Direct Observation of the Infrared Torsional Spectrum of C2H6, CH3CD3 and C2D6; Princeton; Weiss and Leroi; AD-656 908

Strengths, Widths, and Shapes of the Lines of the 3nu CO Band; Philco-Ford Corp.; Burch and Gryvnak; AD-657 114

Absorption by CO2 Between 1800 and 2850/cm (3.5-5.6 Microns); Philco-Ford Corp.; Gryvnak *et al;* AD-657 115

Absorption by CO2 Between 7125 and 8000/cm (1.25-1.40 Microns); Philco-Ford Corp.; Burch *et al;* AD-657 116

Spectroscopy of EDA Complexes at High Pressures. Absorption of Crystalline TCNE Complexes; Calif. U.; Kadhim and Offen; AD-657 123

Vibrational Relaxation in CO2/D20 Mixtures; Miss. U.; Shields and Burks; AD-657 198

Measurement of Relaxation Times of Concentration Fluctuations by the Electric Field Effect on Critical Opalescence; Cornell U.; Debye and Gravatt; AD-657 208

The Dichroism and Birefringence of Polymers Containing Polyene Segments; Mass. U.; Shindo and Stein; AD-657 352

Pyrex Membrane Potential in Binary Nitrate Melts; Miami U.; Keenan *et al;* AD-657 447

Low-Field Zeeman Effect of the Microwave Spectrum of the OH Radical; Oklahoma U.; Lin; AD-657 496

Experimental Investigation of the Infrared Absorption by Atmospheric Gases; Philco-Ford Corp.; Burch *et al;* AD-657 614

Absorption by H2O Between 5045-14,485/cm (0.69-1.98 Microns); Philco-Ford Corp.; Burch and Gryvnak; AD-657 629

Pressure Broadening of Rotational Lines: Sudden Perturbation Approximation; Tufts U.; Trindle and Illinger; AD-657 706

Study of the Effect of Liquid Environment on the Embrittlement of Solids; N.Y. Univ.; Cadoff; AD-657 854

Simplified Procedures for Estimating Band and Total Emissivities of Polyatomic Molecules; Calif. U.; Penner and Varanasi; AD-657 982

Spectral Absorption Coefficients in the Pure Rotation Spectrum of Water Vapor; Cal. U.; Penner and Varanasi; AD-657 983

Irradiation of KCl Crystals Containing KSH; U. of Western Ontario, London; Facey and Jacobs; AD-657 604

NO + O Chemiluminescent Reaction Using Adiabatically Expanded Nitric Oxide; Aerochem Research Labs; Fontijn and Rosner; AD-657 657

EARTH SCIENCES AND OCEANOGRAPHY

Remote Sensing Papers at the AAAS-Impact and Implications; Fla. Atlantic Univ.; Latham; AD-657 628

Coprecipitation of Zinc With Calcium Carbonate; M.I.T.; Crocket and Winchester; AD-657 730

A Historical Geography of the Santa Marta Area, Colombia; Calif. U.; Krogzemis; AD-657 858

Paleoclimatic Interpretations of Some Mesozoic Floral Sequences; Arctic Inst. of North America; Smiley; AD-658 301

The Stratigraphy of Tjornes, Northern Iceland, and the History of the Bering Land Bridge; Arctic Inst. of North America; Einarsson *et al;* AD-658 306

The Geology of the Western Approaches of the English Channel. The Continental Margin and Shelf Under the South Celtic Sea; Woods Hole; Hersey and Whittard; AD-658 405

Transitional Types of Crust Under Small Ocean Basins; Scripps; Menard; AD-658 406

The Orinoco Delta; Scripps; Van Andel; AD-658 407

The Puerto Rico Trench; Woods Hole; Bunce; AD-658 402

Gravity Over Trenches and Rifts; Woods Hole; Bowin; AD-658 403

Calculating Thermal Regime and Mass-Budget of Sea Ice; Wash. U.; Untersteiner; AD-657 921

Sea Ice; Wash. U.; Untersteiner; AD-657 924

Oceanic Electric Currents, Geomagnetic Variations and the Deep Electrical Conductivity Structure of the Ocean-Continent Transition of Central California; Scripps; Filoux; AD-657 935

Physical, Chemical, and Biological Data From the Northeast Pacific Ocean: Columbia River Effluent Area, 1965; Wash. U.; Beck; AD-657 130

The Ocean Science Program of the U.S. Navy: Accomplishments and Prospects; Office of the Oceanographer of the Navy; AD-657 389

Hydrocarbons in Digestive Track and Liver of a Basking Shark; Woods Hole; Blumer; AD-657 412

Vertical Exaggeration in Three-Dimensional Mapping; Kansas U.; Jenks and Caspall; AD-657 441

Analysis of Tidal Current Observations Over the Northeastern Shelf of the Gulf of Mexico; Texas A and M U.; Durham and Reid; AD-656 910

A Sequence of Current Patterns in the Gulf of Mexico; Texas A and M U.; Leipper; AD-656 911

Current Measurements in the Canadian Basin of the Arctic Ocean, Summer, 1965; Wash. U.; Galt; AD-657 120

Comparative Waveform Analysis of Multisensor Imagery; Fla. Atlantic U.; Latham and Witmer; AD-657 529

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Coastal Geomorphology of Connecticut; Cornell U.; Bloom; AD-657 200

St. Peter and St. Paul Rocks: A High-Temperature, Mantle-Derived Intrusion; Woods Hole; Melson *et al;* AD-657 419

Metamorphism in the Mid-Atlantic Ridge, 22 Degrees N Latitude; Woods Hole; Melson and Van Andel; AD-657 420

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Some Towed Line Hydrophone Arrays for Seismic Reflection Profiling; Lamont; Windisch and Ewing; AD-656 936

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An On-Line System for Algebraic Manipulation; M.I.T.; Fenichel; AD-657 282

A Hand-Printed Character Recognition Experiment; Northwestern U.; Steingrandt and Yau; AD-657 425

Integrated Direct-Coupled Gyrator; Stanford; Chua and Newcomb; AD-657 108

Transmission-Line Distributed Amplifiers Utilizing Field-Effect Transistors; Harvard U.; Hopkins and Pandiscio; AD-657 170

Precision Hydrophones for the Null Steering Array; Scripps; Anderson and Cherry; AD-657 929

The Design of a Graphic Display System; Calif. U.; Coggan; AD-658 314

Random Store and Forward Communication Networks With Applications to Pattern Recognition; Columbia U.; Shapiro; AD-658 136

MATERIALS

Crack Theory and Stress Analysis of Composite Systems; Monsanto Research Corp.; Bower *et al;* AD-488 381

Rheology of Filled Systems; Monsanto Research Corp.; Bower *et al;* AD-488 382

Surface Energy; Monsanto Research Corp.; Bower *et al;* AD-488 383

Tapes and Ribbons in Composites; Monsanto Research Corp.; Bower *et al;* AD-488 384

Experimental Data to Support Existing Theories on the Physical and Mechanical Properties of Composite Materials; Monsanto Research Corp.; Bower *et al;* AD-488 386

Surface Migration or Diffusion of Gases or Liquids Along Solid Interfaces; Monsanto Research Corp.; Bower *et al;* AD-488 388

Examination of Fracture Surfaces by Scanning Electron Microscopy; Monsanto Research Corp.; Fairing and Calfee; AD-657 863

Fibers for High Performance Composites; Monsanto Research Corp.; Bower *et al;* AD-488 387

The Rheology of Fibrous Materials in Low Viscosity Media; Monsanto Research Corp.; Bower *et al;* AD-488 389

An X-Ray Diffraction Study of Polycrystalline Brass Deformed in Tension; Martin Co.; Otte and Adler; AD-658 098

The Relationship Between Molecular Structure, Morphology, and the Mechanical Properties of Materials; Mellon Inst.; AD-487 484

The Embrittlement of Copper-17 Atomic % Aluminum Alloy by Liquid Mercury; McMaster U.; Ives and Hancock; AD-657 379

Strain-Induced Phase Transformation in Metastable Cu-Si Solid Solutions; Wash. U.; Kasen *et al;* AD-657 498

Surfaces and Interfaces in Materials Technology; Martin Co.; Westwood and Lye; AD-657 380

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A Class of Epsilon Bayes Tests of a Simple Null Hypothesis on Many Parameters in Exponential Families; Stanford; Morris; AD-656 909

A Note on Cauchy's Theorem; Carnegie Inst. of Tech.; Gurtin *et al;* AD-656 923

Functions of Processes With Markovian States; Mich. St. U.; Fox and Rubin; AD-657 176

On Algebras of Finite Representation Type; Oregon U.; Dickson; AD-657 251

Symbolic Mathematical Laboratory; M.I.T.; Martin; AD-657 283

The Linear Equations Problem; Stanford; Givens; AD-657 448

Collectively Compact Operator Approximations. Lectures Presented July-August 1967; Stanford; Anselone and Smith; AD-657 450

Inadmissibility of Various 'Good' Statistical Procedures Which are Translation Invariant; Mich. St. U.; Perng; AD-657 463

Mathematical Programming; Northwestern U.; Fiacco; AD-656 904

Generation and Approximation of Reach and Distribution of Frequencies; Northwestern U.; Charnes *et al;* AD-656 905

The Current State of Chance-Constrained Programming; Northwestern U.; Kirby; AD-656 907

Optimal Investment and Consumption Strategies Under Risk, and Uncertain Lifetime, and Insurance; Calif. U.; Hakansson; AD-657 034

The Structure of Utility Functions; Stanford; Gorman; AD-657 126

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A Note on Some Stochastic Approaches to Nonstochastic Discrete Programming; Carnegie; Glover; AD-657 431

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What is a Satisfactory Quadratic Equation Solver; Stanford; Forsythe; AD-657 639

How to Solve Linear Inequalities; Calif. U.; Gale; AD-658 095

Discounted Production Scheduling and Employment Smoothing; Stanford; Lippmen and Yuan; AD-657 624

On the Geometry of Optimal Strategies in Two-Person Games of Kind; Calif. U.; Blaquiere and Gerard; AD-657 635

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Fabrication Techniques for High Performance Composite Materials; Monsanto Research Corp.; Bower *et al;* AD-488 380

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Analytical and Experimental Investigations into the Stability Characteristics of Gas-Lubricated Tilting-Pad Journal Bearings; Franklin Inst.; McCabe and Decker; AD-657 538

Determination of Gas-Bearing Stability by Response to a Step-Jump; Franklin Inst.; Elrod, Jr. *et al;* AD-657 539

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Geology From a Deep-Diving Submersible; Woods Hole; Schlee; AD-657 644

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Shipboard Machinery Analyzer; General Electric Co.; Schlereth and Fancett, Jr.; AD-658 156

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A Demand Prediction Technique for Items in Military Inventory Systems; Geo. Wash. U.; Haber *et al;* AD-657 180

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Dome Effectiveness and the Scaling and Area Dependence of Boundary Layer Pressure Spectra Viewed With Regard to Characteristic Wavenumber Ranges; Trg. Inc.; Chase; AD-657 371

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Subharmonic Generation in an Acoustic Fabry-Perot Interferometer; Mich. St. U.; Bamberg; AD-657 185

Transmission and Reflection of Sound in a Media Containing Discrete Scatterers; CalTech; McCloskey; AD-657 209

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Random Noise

Dr. James H. Schulman, formerly Superintendent of NRL's Optical Physics Division, has been named Associate Director of Research for Materials at NRL. In addition to administering a broad program of basic and applied investigations in solid state, chemistry, and metallurgy, Dr. Schulman is responsible for NRL's Shock and Vibration Information Center, Combustion Suppression Center, and Laboratory for Structure of Matter.

Dr. Scott C. Daubin, formerly head of the Marine Sciences Section, General Motors Corporation, has been appointed as Senior Scientist and Chairman of the Department of Ocean Engineering at the Woods Hole Oceanographic Institution. Dr. Daubin, who was responsible for GM's deep diving submarine, the Deep Ocean Work Boat, has conducted studies involving very long range, low frequency acoustic propagation in the ocean and the attempts to locate and identify the sources of these signals.

Mr. George Tselepis, a civil engineer with the Naval Oceanographic Office, recently received a Superior Civilian Service commendation for his work in Vietnam. He accompanied a survey team through enemy-controlled territory, personally operating much of the hydrographic equipment and recording valuable corollary information.

Dr. Boyd E. Olson has recently been named Deputy Scientific and Technical Director of the Naval Oceanographic Office, Washington, D.C. Dr. Olson previously served as director of the NOO Marine Sciences Department.

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CAPT Kingston Receives Gorgas Medal

CAPT James R. Kingston, MC, USN, Special Assistant to the Chief of Naval Research for Medical and Allied Sciences, was recently presented the 1967 Gorgas Medal and cited by the Association of Military Surgeons and the Wyeth Laboratories for his success in medical research, his leadership as a military officer, and his continued devotion to the prevention of diseases that afflict mankind.

The Gorgas Medal, dedicated to the memory of Surgeon General William Crawford Gorgas whose work in preventive medicine made possible the construction of the Panama Canal, was established in 1942 by the Wyeth Laboratories working with the Association of Military Surgeons of the United States. Presentation of the medal, the purpose of which is to honor the significant role of preventive medicine in peace and war, was made by Mr. Arthur R. Gallagher, Wyeth Laboratories, on November 21, 1967 during the annual meeting of the Association of Military Surgeons.

During his career, CAPT Kingston has conducted research in virology at several Navy Medical Research Centers. In 1955, he became Deputy Director of the Research Division of the Navy's Bureau of Medicine and Surgery. In that capacity, he planned, organized, and directed a scientific study of respiratory diseases at the Marine Corps Recruit Depot, Parris Island, South Carolina. In that study, he identified the Eaton Agent as the organism that is the principal cause of primary atypical pneumonia and proceeded to establish an effective treatment for that disease. For this action, he was presented with the Legion of Merit.

CAPT Kingston has published many articles, including units on typhus and Q fever in Egypt and the Sudan, on arthropod-borne viruses, and on the prevention of heat casualties. Several of his studies have dealt with heat stress and its effect on military operations, particularly on aircraft carriers.

The citation that accompanied the Gorgas Medal reads as follows:

As a distinguished scientist and medical administrator, CAPT Kingston has made outstanding contributions to the improvement of the health of Navy and Marine Corps personnel. His studies in the laboratory and the field have resulted in significant additions to knowledge of arthropod-borne diseases, the etiology and control of acute respiratory diseases, and the control of heat stress in naval environments. He has gained national and international prominence and his accomplishments bring great credit to himself, his profession, and his country.

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The Navy's hydrofoil gunboat, the TUCUMCARI PGH-2, "flies" over the water at speeds over 40 knots on a test run near Seattle, Washington. The hydrofoil, which may be the forerunner of a fleet of swift, special-mission Navy craft, is powered by a water-jet propulsion system. *See page 31.*